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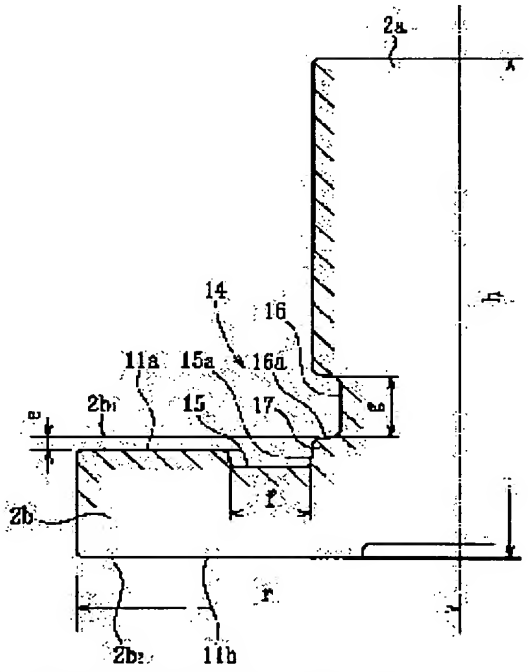
(54) DYNAMIC-PRESSURE TYPE BEARING UNIT

(57)Abstract:
PROBLEM TO BE SOLVED: To largely cut down on costs by enhancing the accuracy of the squareness between a shaft section and a flange section.
SOLUTION: The shaft section 2a and the flange section 2b are forged in one piece to form a shaft member 2. A lightening section 14 is formed at a corner 13 between the shaft section and the flange section, and this lightening section 14 comprises a first lightening section 15 formed at the edge face of the flange section by forging and a second lightening section 16 formed at the external periphery of the shaft section by rolling.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The shank material which has a shank and a flange, and the radial bearing section which carries out non-contact support of the shank in a radial direction with the fluid dynamic pressure generated in the radial bearing clearance, In the dynamic pressure mold bearing unit which has the thrust shaft receiving part which carries out non-contact support of the flange in the thrust direction with the fluid dynamic pressure generated in the thrust-bearing clearance The dynamic pressure mold bearing unit characterized by preparing the ** finishing section which really fabricated shank material with forging, and was formed in the corner between a shank and a flange by forging or rolling.
[Claim 2] The shank material which has a shank and a flange, and the radial bearing section which carries out non-contact support of the shank in a radial direction with the fluid dynamic pressure generated in the radial bearing clearance, In the dynamic pressure mold bearing unit which has the thrust shaft receiving part which carries out non-contact support of the flange in the thrust direction with the fluid dynamic pressure generated in the thrust-bearing clearance While preparing the first ** finishing section which really fabricated shank material with forging and was formed by the plastic deformation of shaft orientations near the shank periphery among flange end faces The dynamic pressure mold bearing unit characterized by preparing the second ** finishing section formed by radial plastic deformation near the flange end face among shank peripheries.
[Claim 3] The dynamic pressure mold bearing unit according to claim 2 which formed the first ** finishing section by forging, and formed the second ** finishing section by rolling.
[Claim 4] The information machine dexterous spindle motor supported free [rotation of a spindle] at the dynamic pressure mold bearing unit indicated they to be [any of claims 1-3].

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the suitable bearing unit for spindle support of an information machine dexterous spindle motor especially about the dynamic pressure mold bearing unit which carries out non-contact support of the shank material (spindle) with the fluid dynamic pressure produced in the bearing clearance. The spindle motor which drives magnetic disks, such as magneto-optic disks, such as optical disks, such as for example, CD-R/RW, and DVD-ROM/RAM, and MO, and a hard disk, a laser beam printer (LBP), the polygon scanner motor of a copying machine, etc. are contained in a "information machine dexterous spindle motor" here.
[0002]
[Description of the Prior Art] As bearing which supports the spindle of the information machine dexterous spindle motor represented by the magnetic disk drive, although anti-friction bearing was common conventionally, the example replaced with dynamic pressure mold bearing equipped with the description which was [nature / high rotation precision, quantity attenuation nature, / low noise] excellent in recent years in this has increased. As this kind of dynamic pressure mold bearing, what carries out non-contact support of the shank material used as a spindle in a radial direction and the thrust direction is known by making the radial bearing clearance between the radial bearing sections, and the thrust bearing clearance between the thrust bearing sections generate dynamic pressure, respectively (for example, JP,12-220633,A etc.).
[0003]
[Problem(s) to be Solved by the Invention] Thus, as the both sides of the radial bearing section and the thrust bearing section are shown in drawing 4 as shank material of the bearing unit constituted from dynamic pressure mold bearing, what carried out press fit immobilization of the flange 22 disc-like to the axis end of a shank 21 is known.
[0004] However, it is difficult to be stabilized and to obtain highly precise squareness between a shank 21 and a flange 22, on the relation which presses a shank fit in a flange with this structure. Therefore, contact to the both-ends side of a flange 22 and the field which counters at this is caused during operation of bearing, and there is a possibility of injuring the bearing engine performance. Since the shank and the flange are already incorporated in the unit even if it is going to measure squareness after assembly, even if the precision measurement and check are generally difficult and possible, they will require a complicated activity and will cause increase of assembly cost etc.
[0005] Then, this invention aims at offer of the dynamic pressure mold bearing unit which can make the squareness between a shank and a flange highly precise, and can be manufactured to low cost.
[0006]
[Means for Solving the Problem] The squareness between a shank and a flange can unify a shank and a flange, and can make them highly precise by machining managing this unified shank material so that squareness may turn into a predetermined precision. Although lathe turning is common as the machining approach of this kind of one apparatus shank material, in order for

processing to take long duration, processing cost soars by lathe turning.
[0007] On the other hand, after processing of shank material needs to perform a grinding process to the front face of shank material as finish-machining. not alike [between a shank 21 and a flange 22 / corner 23] at the time of this grinding process, so that it may expand to drawing 5 and may be shown -- it is necessary to end and to form the section 24 Although forming by lathe turning is common as for this ** finishing section 24, it is not desirable in order for processing to take long duration by lathe turning.
[0008] The shank material which has a shank and a flange by this invention in consideration of the above point, The radial bearing section which carries out non-contact support of the shank in a radial direction with the fluid dynamic pressure generated in the radial bearing clearance, In the dynamic pressure mold bearing unit which has the thrust shaft receiving part which carries out non-contact support of the flange in the thrust direction with the fluid dynamic pressure generated in the thrust-bearing clearance It considered as the configuration which prepared the ** finishing section which really fabricated shank material with forging, and was formed in the corner between a shank and a flange by forging or rolling.
[0009] Thus, by really fabricating shank material by forging, highly precise squareness can be obtained between a shank and a flange. Moreover, by forming the ** finishing section by forging or rolling, it can end, the floor to floor time of the section can be shortened, and the processing cost of shank material can be conjointly reduced sharply with the thing which is not compared when processing this by lathe turning and which carry out forging shaping of the whole shank material. In this case, since processing according that it is the inclined special configuration (for example, alpha= 27.5 degrees, beta= 27.5 degrees, theta= 35 degrees, about RO=0.1) as the ** finishing section shows to drawing 5 to forging or rolling becomes difficult, as for the ** finishing section, it is desirable to constitute from a crevice the configuration which does not incline where it does not incline, for example, shaft orientations, and radial.
[0010] Moreover, shank material is really fabricated with forging, and while preparing the first ** finishing section formed by the plastic deformation of shaft orientations near the shank periphery among flange end faces, the second ** finishing section formed by radial plastic deformation near the flange end face among shank peripheries can also be prepared. In order to form the ** finishing section 24 of the letter of an inclination shown in drawing 5 by plastic working, it is necessary to develop the processing equipment of dedication but, and if the first ** finishing section and the second ** finishing section are formed by shaft orientations and radial plastic deformation as mentioned above, a general-purpose article can be used as processing equipment, and the jump of a manufacturing cost will be suppressed.
[0011] In this case, the first ** finishing section can be formed with forging, and the second ** finishing section can be formed by rolling. Thereby, large shortening of floor to floor time can be attained compared with the case where the ** finishing section is formed, by lathe turning.
[0012] Thus, by carrying out plastic working (forging and rolling) of the whole shank material containing the ** finishing section in this invention While skipping a lathe-turning process and aiming at reduction of processing cost, it is what realizes highly precise finishing dimensions (squareness etc.) by really fabricating shank material by forging (the grinding process of the whole shank material is carried out further after that). It is compatible on high level in processing cost and process tolerance.
[0013] By supporting a spindle by the dynamic pressure mold bearing unit of the above configuration, enabling free rotation, highly-precise-izing of an information machine dexterous spindle motor and low cost-ization are attained.
[0014]
[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained based on drawing 1 - drawing 5 .
[0015] Drawing 1 has illustrated the HDD spindle motor equipped with the dynamic pressure mold bearing unit 1 concerning this invention. This spindle motor is attached in the shank material 2 with the bearing unit 1 supported for the shank material 2, enabling free rotation, and has the motor stator 4 and the motor rotor 5 which magnetic-disk D was made to counter through 1 or the disk hub 3 held two or more sheets, and a radial gap. A stator 4 is attached in

the cylindrical periphery section holding a bearing unit 1 of casing 6, and Rota 5 is attached in the inner skin of the disk hub 3. If it energizes to a stator 4, Rota 5 will rotate by the excitation force between a stator 4 and Rota 5, and the disk hub 3 and the shank material 2 will rotate.
[0016] When it is fixed to the shank material 2 and the turntable (illustration abbreviation) which carries out support immobilization of these disks when using a bearing unit 1 for the spindle motor of other information machine dexterous spindle motors, for example, an optical disk drive, or a magneto-optic disk uses it for the polygon scanner motor of LBP, a polygon mirror (illustration abbreviation) is fixed to the shank material 2.
[0017] A bearing unit 1 uses as main components the shank material 2 which consists of flange 2b which projects in the outer-diameter side of shank 2a and shank 2a, the so-called closed-end cylinder-like bag type housing 9, the bearing member 7 of the shape of a thick cylinder fixed to the inner skin of housing 9, and the seal members 8, such as a seal washer which seals the end side of a bearing member. In addition, in the following explanation, the side (drawing lower part) which it obturated by pars-basilaris-ossis-occipitalis 9a of housing 9 among shaft-orientations both sides is called an "obturation side", and the opposite side (drawing upper part) is called a "anti-obturation side."
[0018] The shank material 2 consists of flange 2bs prepared in the obturation side edge section of shank 2a and shank 2a. Flange 2b is held for shank 2a of the shank material 2 in the inner circumference of the bearing member 7, respectively between the bearing member 7 and pars-basilaris-ossis-occipitalis 9a of housing 9. Although the shank material 2 is formed with a metallic material, it is desirable to consider to press a motor rotor fit in shank 2a like the after-mentioned, and to form with the iron system ingredient of a high degree of hardness, for example, stainless steel, (SUS420 grade).
[0019] The bearing member 7 is formed with elasticity metals, such as copper and brass. Radial bearing side 10a which has two or more slots for dynamic pressure generating (dynamic pressure slot) is formed in the inner skin of the bearing member 7. From this, at the time of relative rotation of the shank material 2 and the bearing member 7 (at the time [This operation gestalt] of rotation of the shank material 2) The dynamic pressure of the fluids (lubricating oil etc.) filled in the radial bearing clearance Cr between the peripheries of radial bearing side 10a and shaft 2a occurs, and the radial bearing section 10 which carries out non-contact support of the shank 2a in a radial direction is constituted. The bearing member 7 may be formed with a sintered metal, and the oil impregnation sintered metal which infiltrated a lubricating oil and lubricating grease in that case, and made the interior hold an oil is used as the above-mentioned bearing member 7. In addition, the width of face of the radial bearing clearance Cr in drawing is exaggerated and drawn (the same is said of the below-mentioned thrust bearing clearances Ct1 and Ct2).
[0020] The thrust bearing clearances Ct1 and Ct2 which are clearances between shaft orientations are established in the shaft-orientations both sides of flange 2b. One thrust-bearing clearance Ct1 is formed between anti-obturation side edge side 2b1 of flange 2b, and end-face 7a of the bearing member 7 which counters this, and the thrust-bearing clearance Ct2 between another side is formed between obturation side edge side 2b2 of flange 2b, and pars-basilaris-ossis-occipitalis 9a of the housing 9 which counters this. The thrust bearing sides 11a and 11b which have two or more dynamic pressure slots, respectively are formed, at the time of the above-mentioned rotation, in both-ends side 2b1 of flange 2a, and 2b2, fluids, such as a lubricating oil filled in the thrust bearing clearances Ct1 and Ct2, produce dynamic pressure, and the thrust bearing section 11 which carries out non-contact support of the flange 2b from the thrust direction both sides is constituted from this.
[0021] the shape of a dynamic pressure quirk of above-mentioned radial bearing side 10a and the thrust bearing sides 11a and 11b can be chosen as arbitration, and is well-known -- it can pass, and can choose any, such as a ring bone mold, a spiral mold, a step mold, and a multi-radii mold, they are, or can be used, combining these suitably. In drawing 1 , although radial bearing side 10a is formed in the inner skin of the bearing member 7, this can also be formed in the peripheral face of shank 2a. Moreover, the thrust-bearing sides 11a and 11b can also be formed in the pars-basilaris-ossis-occipitalis 9a end face of end-face 7a of the bearing member 7, or housing 9 which counters both-ends side 2b1 of flange 2b, and 2b2.

[0022] The above-mentioned bearing unit 1 inserts the shank material 2 towards a flange 2b obturation-side into housing 9, and is assembled by pressing fit or pasting up the bearing member 7 on the predetermined location of housing 9 inner circumference so that the thrust-bearing clearances Ct1 and Ct2 between predetermined width of face (about 10-20 micrometers) may be formed further. And the spindle motor shown in drawing 1 is assembled by pressing fit or pasting up this bearing unit 1 on the cylindrical inner circumference section of casing 6, and pressing fit in the anti-obturation side edge section of shank 2a the assembly (motor rotor) which consists of Rota 5 or a disk hub 3 further.
[0023] In this invention, the shank material 2 which consists of shank 2a and flange 2b is formed in one of forging. Thus, since the precision of the squareness after processing can be raised easily, and squareness moreover becomes measurable by managing correctly the squareness between shank 2a and flange 2b for the shank material 2 during integral construction, then its processing before the nest to a bearing unit, precision measurement and its check can also be performed easily. By fabricating the shank material 2 by forging, compared with the case where this is fabricated by lathe turning, floor to floor time can be shortened sharply (about 1/10), and it becomes possible to reduce a manufacturing cost sharply.
[0024] A grinding process is performed to the front face of the shank material 2 after forging termination as finish-machining. In order to prevent interference with the grinding stone under this grinding process, and fields other than a processed field, as shown in drawing 2 , the ** finishing section 14 is formed in the corner 13 between the periphery of shank 2a, and anti-obturation side edge side 2b1 of flange 2b.
[0025] The ** finishing section 14 consists of the first ** finishing section 15 formed in anti-obturation side edge side 2b1 of flange 2b, and the second ** finishing section 16 formed in the periphery of shank 2a. Any ** finishing sections 15 and 16 are the circular sulci centering on an axial center, and the bottom is located in the location which caved in rather than the peripheral face of flange end-face 2b1 and shank 2a, respectively. The first ** finishing section 15 is formed by carrying out plastic deformation of near the shank 2a periphery to shaft orientations among anti-obturation side edge side 2bs1 of flange 2b, and the second ** finishing section 16 is formed by carrying out plastic deformation of near flange end-face 2b1 to radial among shank 2a peripheries. The first ** finishing section 15 can be formed with forging, the second ** finishing section 16 can be formed by rolling, respectively, and rolling of the second ** finishing section 16 is performed after the completion of forging of the first ** finishing section 15 in that case.
[0026] Although bore edge 15a of the first ** finishing section 15 is allotted on the production of a shank 2a periphery in the example of illustration, bore edge 15a may be arranged to an outer-diameter side rather than this. Moreover, although prepared in the location where only distance e shifted obturation side edge section 16a of the second ** finishing section 16 to the anti-obturation side rather than end-face 2b1 of flange 2b in the example of illustration, obturation side edge section 16a may be prepared on the production of flange end-face 2b1 (e= 0). If this distance e is too large, since it will become difficult for the distance between both the ** finishing section 15 and 16 to be expanded, and to demonstrate the function as the ** finishing section 14, it is desirable to set distance e to 0.5mm or less (0<=e<=0.5mm).
[0027] Although it is desirable to perform forging of the first ** finishing section 15 to forging and coincidence of the shank material 2 whole for shortening of floor to floor time, as long as floor to floor time does not pose a problem so much, forging shaping of the first ** finishing section 15 may be carried out at another process after forging of the shank material 2. When forming thrust-bearing side 11a by the side of anti-obturation in end-face 2b1 of flange 2b like illustration, coincidence shaping of thrust-bearing side 11a and the first ** finishing section 15 which have a dynamic pressure slot can also be carried out with a press etc. The plastic flow of a metal texture accompanying forming of rolling of the second ** finishing section 15 is mainly absorbed by both the ** finishing section 15 and the boundary section 17 between 16.
[0028] The radial width of face f of the first ** finishing section 15 is set as about 0.03 <=f/r<=0.20 to the flange radius r, and the shaft-orientations width of face g of the second ** finishing section 16 is set as about 0.01 <=g/h<=0.05 to shaft-orientations die-length h of the shank material 2. Moreover, the depth of both the ** finishing sections 15 and 6 is set as about

0.05-0.4mm (drawing 2 is exaggerating and drawing the magnitude of both the ** finishing sections 15 and 16).
[0029] After formation of the second ** finishing section 16, grinding processing is performed to the shank material 2. Heat treatment of induction hardening etc. is performed to the shank material 2 which grinding completed, and it hardens to surface hardness 500-550Hv here.
[0030] As mentioned above, by this invention, since the ** finishing section 14 is formed by forging and rolling, compared with the case where this is formed by lathe turning, floor to floor time can be shortened sharply. Moreover, since the first and second ** finishing sections 15 and 16 are formed of shaft orientations and radial plastic deformation, the processing equipment of dedication like [in the case of forming the ** finishing section 24 of the letter of an inclination shown in drawing 5] is unnecessary, and can divert conventional processing equipment to some other purpose as it is. As mentioned above, according to this invention, large low cost-ization of the shank material 2 is conjointly attained with carrying out forging shaping of the shank material 2 whole.
[0031] Since it is necessary to form center holes 26 and 27 in the both ends of the shank material 2 beforehand but as shown in drawing 4 , and this kind of center hole will become unnecessary if the shank material 2 is formed by forging as mentioned above when processing the shank material 2 by lathe turning, a processing man day decreases and further low cost-ization is attained only for that part.
[0032] Other operation gestalten of this invention are shown in drawing 3 . This bearing unit 1 is the structure which unified housing 9 and the bearing member 7 in drawing 1 , considered as bearing member 7' of a simple substance, and obturated pars-basilaris-ossis-occipitalis opening of the bearing member 7' concerned by the lock out member 19 of another member. thrust bearing -- a clearance -- Ct -- one -- Cs -- two -- inside -- anti- -- obturation -- a side -- thrust bearing -- a clearance -- Ct -- one -- a flange -- 2b -- anti- -- obturation -- a side edge -- a field -- 2b -- one -- this -- countering -- bearing -- a member -- seven -- ' -- an end face -- seven -- a -- ' -- between -- forming -- having -- obturation -- a side -- thrust bearing -- a clearance -- Cs -- two -- a flange -- 2b -- obturation -- a side edge -- a field -- 2b -- two -- this -- countering -- lock out -- a member -- 19 -- an end face -- between -- forming -- having .
[0033] The same effectiveness as the above is acquired by forming the same ** finishing section 14 as drawing 2 in shank 2a of the shank material 2 really fabricated also in this case, and the corner 13 between flange 2bs. Since the member and elements other than [in drawing 3] this are the same as that of what is shown in drawing 1 , they attach a reference number common to common member and element, and omit duplication explanation.
[0034]
[Effect of the Invention] According to this invention, it becomes possible to be able to obtain highly precise squareness, since shank material is unified, and to measure squareness, also before the nest to a bearing unit. Therefore, the bearing engine performance which prevented contact to a flange and other members (pars basilaris ossis occipitalis of a bearing member or housing), and was stabilized can be obtained, and the further high-degree-of-accuracy-ization of information machine dexterous spindle motors, such as HDD, is attained. Moreover, since shank material is altogether fabricated by processing (forging and rolling) accompanied by plastic deformation including the ** finishing section, special processing equipment like [in the case of being able to shorten floor to floor time sharply compared with the case where it fabricates by lathe turning, and forming the ** finishing section of the letter of an inclination] becomes unnecessary. Therefore, large low cost-ization of a bearing unit and the information machine dexterous spindle motor which incorporated this further is attained.

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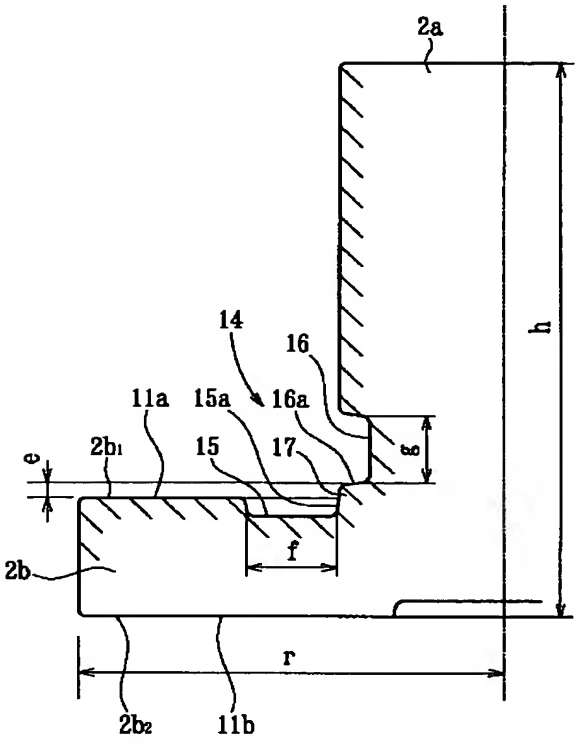
Drawing selection Representative drawing



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